

## **REMARKS/ARGUMENTS**

Reconsideration of this application is requested. Claims 12-18 and 20-22 are in the case.

### **I. THE INTERVIEW**

At the outset, the undersigned wishes to thank the Examiner and her supervisor for conducting an interview in this case. The interview was held on October 19, 2010, the courtesies extended by the Examiner and her supervisor were most appreciated. The substance of the interview will be clear from the Interview Summary and from the comments presented below.

### **II. THE OBVIOUSNESS REJECTIONS**

Claims 12-19 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Murray (US 2003/0171206), in view of Jenkins III *et al.* (US 4,588,790 or 4,543,399) (Jenkins). Claim 17 is rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Murray in view of Jenkins and further in view of Muhle *et al.* (US 6,180,736) (Muhle). Claims 19-20, and 22 are rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Murray and further in view of Babb *et al.* (US 6,627,573) (Babb). Claim 21 is rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Murray in view of Devore *et al.* (US 5,470,993) (Devore) and further in view of Babb. The rejections are respectfully traversed.

During the interview, the Examiners indicated that it would be preferable for the claims to more positively recite the step methodology of the claimed process. Claim 12

has been amended to do this. Thus, as now claimed, there is a provided a process for the copolymerisation of ethylene and an  $\alpha$ -olefin having 7 to 10 carbon atoms comprising the steps of providing a fluidised bed gas phase reactor having a reaction zone and a recycle stream, providing a single site polymerisation catalyst in the gas phase reactor which is a metallocene complex represented by the general formula  $L_xMQ_n$  wherein L is a cyclopentadienyl ligand, M is titanium, zirconium or hafnium, Q is a leaving group and x and n are dependent on the oxidation state of the metal, and bringing the ethylene and the  $\alpha$ -olefin having 7 to 10 carbon atoms into contact with the single site polymerization catalyst in the reaction zone at a controlled reaction temperature under condensed mode conditions to form a monomer mixture. The condensed mode conditions in the reaction zone are provided by introducing the recycle steam comprising a liquid and a gas phase. The partial pressure of the alpha-olefin in the reaction zone is maintained below an amount which would, at a temperature of  $10^{\circ}\text{C}$  less than the controlled reaction temperature of the monomer mixture in the reaction zone, be the saturated vapor pressure of the alpha-olefin, to thereby prevent condensation of the alpha olefin in the reaction zone.

As discussed during the interview, the presently claimed process requires the use of a metallocene catalyst as recited in previous claim 19 and as described at page 4, beginning at line 15. The metallocene complex is defined as having the general formula  $L_xMQ_n$ , wherein L is a cyclopentadienyl ligand, M is titanium, zirconium or hafnium, Q is a leaving group and x and n are dependent on the oxidation state of the metal.

It has been discovered, surprisingly, according to the present invention, that in order to operate copolymerizations using higher  $\alpha$ -olefins as comonomers in condensed mode operation, it is advantageous to operate the process in the presence of a metallocene complex comprising a metal selected from titanium, zirconium or hafnium, such that the amount of the  $\alpha$ -olefin is maintained below that at which substantial condensation in the reactor occurs. In other words, according to the claimed process, the partial pressure of the alpha-olefin in the reaction zone is maintained below an amount which would, at a temperature of 10°C less than the temperature of the monomer mixture in the reaction zone, be the saturated vapor pressure of the alpha-olefin to prevent condensation of the alpha olefin in the reaction zone.

The claimed process is operated under condensed mode conditions by use of, for example, a suitable inert substance in the recycle stream and such that the amount of the  $\alpha$ -olefin (e.g., octene) is maintained below that at which substantial condensation in the reactor occurs. Condensed mode operation is defined in the specification (page 2) as purposefully introducing a recycle stream having a liquid and a gas phase into the reactor. This is now specifically recited in the claims. The introduction is achieved by condensation of the recycle stream **in a heat exchanger**, and **not** in the reactor. The condensation is achieved by means of cooling an inert condensate present in the recycle stream, e.g., pentane. This would have been clearly understood by one skilled in the art based on this definition of introducing a recycle stream containing liquid into the reactor. Several references are mentioned at the bottom of page 2 as supporting this definition of condensed mode.

The condensed mode conditions in the reaction zone are provided by introducing the recycle steam comprising a liquid and a gas phase. By use of the claimed process conditions, higher  $\alpha$ -olefins may be successfully employed in a gas phase process provided the amount of higher  $\alpha$ -olefin comonomer is maintained below that at which substantial condensation occurs. Such operation is also dependent upon the operation temperature and the boiling point of the higher  $\alpha$ -olefin. The process is particularly advantageous when performed in the presence of a metallocene complex comprising a metal selected from titanium, zirconium or hafnium, as now claimed, which is able to incorporate high levels of comonomers at low comonomer inventories.

The Action and the Advisory Action assert that the Murray catalysts may contain a metallocene complex (referring to [0054]). This is not correct.

Murray (para [0057]) discloses that the preferred metal of the organometallic compound is a Group 4 metal most preferably zirconium. The only compounds which resemble metallocene complexes are those on page 4 in which the metals are iron or chromium.

The present amendment to metallocenes having a general formula as defined in amended claim 12 clearly patentably distinguishes over Murray and the other cited art. There is no suggestion in Murray of the metallocenes as now claimed. The ferrocenes and chromocenes listed in Murray (page 4) would not have been considered by one of ordinary skill as suggesting the metallocenes as now defined in the presently claimed process. While the R groups in Murray may include different examples of ring ligands, none are cyclopentadienyl. Moreover, these are substituents on the general formula described in the formula described in paragraph [0040] which is clearly **not** a

metallocene complex. At the top of page 4, ferrocene or chromcene structures are disclosed as suitable R groups, but these must be read as part of the general formula in paragraph [0040].

The Action correctly notes that Murray does not disclose operation in condensed mode. Murray only discloses that single site catalysts may be used for processes operating in the gas phase, one of which may be a fluidized bed process in which a recycle stream is used to return gas to the reactor to maintain the fluidized bed.

Murray, therefore, provides no disclosure or suggestion of the use of metallocene complexes as now claimed. Murray does not suggest operation in condensed mode, nor the polymerization of ethylene and higher alpha-olefins nor the partial pressures according the recited details of amended claim 12.

In the claimed process, the condensed liquid entering the reactor is vaporized since the polymerization temperature in the reaction zone is always greater than the dew point of the recycle stream. Claim 12 requires a temperature of the monomer mixture in the reaction zone. This is a controlled reaction temperature and it is this temperature which is the reference point for the requirement that the partial pressure be kept below an amount which would at a temperature of 10°C or less than the controlled temperature of the monomer mixture in the reaction zone be the saturated vapor pressure of the alpha-olefin. The polymerization process is performed at a certain reaction zone temperature and thus is inherently a “controlled” temperature.

Summarizing, Murray is deficient in four aspects with respect to the claimed process, namely:

1. no metallocene complex having titanium, zirconium or hafnium metals;

2. no operation in condensed mode;
3. no specific teaching of higher alpha-olefins;
4. no specific teaching of partial pressures.

Murray clearly does not give rise to a *prima facie* case of obviousness of the presently claimed process.

The above-discussed deficiencies of Murray are not cured by the cited secondary art. The Jenkins references are directed to polymerization in condensed mode. The Action asserts that it would be obvious to operate the process of Murray in condensed mode as Murray actually refers to the Jenkins references. This is not correct.

Murray refers to many polymerization processes in [0121], including US 4,588,790 and US 4,543,399, but there is no specific direction in Murray to these particular references. The disclosure in [0121] merely represents those types of fluidized bed processes known at the time. In any event, the Murray disclosure is directed to different catalyst systems to those now recited in the presently claimed process.

With respect to the types of comonomers used in Murray, at [0115] a list is disclosed, but this is merely a list of those comonomers known to be typically used in such copolymerization processes. 1-octene and 1-decene are included but only as examples of suitable comonomers having 2-12 carbon atoms. This is a list commonly found in references generally disclosing ethylene copolymerization. All the examples in Murray use 1-hexene as the comonomer. One of ordinary skill would not have been motivated based on Murray to use the higher alpha olefins.

The Action discusses the mole ratios of ethylene and comonomer. The ratios disclosed in [0119] are very general and relate to broad ratios. There is no suggestion of the much narrower and specific ratios as claimed in present claims 15 and 17. As noted in the prior response, present claim 15 defines this ratio for octene as comonomer as 0.0001 to 0.02, and claim 17 for decene as 0.00005 – 0.005. It is clear that the proposed ranges for the present invention may be much lower than the general ranges described in Murray. In addition, there is no specific indication in Murray as to suitable ranges for the higher comonomers such as octene or decene.

Even if all of the above options were chosen by the skilled person from a reading of Murray (it is believed this would not have occurred), there is still no suggestion in Murray of the metallocene complex having titanium, zirconium or hafnium metals, nor of the feature that “the amount of alpha-olefin is maintained below that at which substantial condensation occurs”.

The Action asserts that it would be obvious to arrive at the claimed process from Murray since it is considered that the Murray processes “in condensed mode” would be inherently devoid of “substantial condensation” and that this is because the amount of comonomer is controlled by the temperature and partial pressure in the reaction zone. While the level of condensation is controlled by these factors, the important point is that the skilled person must first have recognized that the level of condensation should be maintained below that at which substantial condensation occurs (or rather the partial pressure /temperature amendment) in order to achieve the advantages of the present invention. This would not have occurred to one of ordinary skill as of the filing date of

the present case. Withdrawal of the obviousness rejection of claims 12-19 over Murray in view of Jenkins (US 4,588,790 or 4,543,399) is respectfully requested.

Dependent claim 17 is rejected over the Murray and Jenkins in view of Muhle. The deficiencies of Murray and Jenkins are discussed above. With regard to Muhle, there is no specific disclosure in this reference of higher alpha olefins. The Action takes the disclosure of Muhle (as with Murray and Jenkins) and generalizes to the specific higher alpha-olefins of the present invention. That the present invention is directed to these higher alpha-olefins is a distinguishing feature over the cited art. This is particularly the case now that the claims are amended to the control of the polymerization process.

None of Murray, Jenkins and Muhle is directed to or highlights the copolymerization of ethylene and higher alpha olefins having 7 to 10 carbon atoms. Some may disclose 1-octene and 1-decene but this is merely as examples of suitable comonomers from a long list. This is a key point with regard to the present invention **together** with the use of metallocene complexes having titanium, zirconium or hafnium metals. Withdrawal of the obviousness rejection of claim 17 over Murray in view of Jenkins and further in view of Muhle is respectfully requested.

Claims 19-20 and 22 are rejected over the combination of Murray and US 5470993 (Devore) or US 6627573 (Babb). Claim 21 is rejected over Murray in view of Devore and further in view of Babb. The rejections are respectfully traversed.

Murray is irrelevant for the reasons discussed above. With respect to Devore, this reference discloses similar catalysts to those of the present invention and their potential use in the gas phase (col. 19). However, the catalysts are described in



general terms as suitable in all types of polymerization processes – solution, suspension, slurry and gas phase. Examples 33-39 are performed in the gas phase but this is not operated in a condensed mode process. There is no indication in Devore of the suitability of the catalysts for gas phase polymerization in condensed mode operation.

With regard to Babb, the Action refers to the disclosure of higher alpha-olefins in Babb at col. 22, lines 14 -18. This is even less of a disclosure of higher alpha-olefins than in Devore. Babb specifically discloses 1-butene, 1-hexene and 4-methyl-1 pentene, but **none** of these meets the requirement of higher alpha olefins having 7 to 10 carbon atoms.

As noted earlier, the subject matter of claim 19 is incorporated into claim 12 to define the catalyst as a metallocene complex. Babb describes metallocene complexes at cols. 12–19, but none of the other features of the claims are disclosed in any direct disclosure in Babb or in Devore. Withdrawal of the rejections of Claims 19-22 over Murray in view of Babb, or over Murray in view of Devore in view of Babb, is respectfully requested.

In summary, Murray, taken alone or in combination with the cited secondary art, does **not** suggest operation in condensed mode of a process for the copolymerisation of ethylene and an  $\alpha$ -olefin having 7 to 10 carbon atoms in a fluidised bed gas phase reactor in the presence of a single site polymerisation catalyst which is a metallocene complex comprising a metal selected from titanium, zirconium or hafnium. Withdrawal of the obviousness rejections is respectfully requested.

**III. AMENDMENTS**

Claim 12 has been amended to positively recite the process steps, and to define the metallocene catalyst as previously claimed in claim 19 and at page 4, beginning at line 15 of the specification. No new matter is entered.

Favorable action is awaited.

Respectfully submitted,

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